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The relationship between children's cognitions and later educational progress in rural South Africa: A longitudinal study

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Abstract

Background:

Children in low and middle-income countries (LMIC) who remain in school have better health and employment outcomes. South Africa, like many LMIC, has a secondary school completion rate under 50%, leaving room for improvement if we can identify factors that affect educational attainment. This is the first longitudinal study to examine the effects of childhood mental health and cognitions on educational outcomes in LMIC.

Methods:

Using the Strengths and Difficulties Questionnaire (SDQ) and Cognitive Triad Inventory for Children (CTI-C), we assessed the psychological functioning and cognition of children aged 10-12 in rural South Africa. We linked that data with measures of educational progress collected five years later and examined associations between educational progress and 1) behavioural and emotional problems and 2) cognitive interpretations, adjusting for possible confounders.

Results:

Educational data was available for 443 individuals. 92% (n= 408) of individuals had advanced three or fewer grades in seven years. Having more positive cognitions (CTIC-C) was positively associated with progressing at least three grade levels (adjusted OR: 1.43; 95% CI: 1.14-1.79). There was no evidence for an association between emotional and behavioural problems (SDQ) and educational progress (OR: 0.90; 95% CI: 0.72-1.11).

Conclusion:

If children in LMIC can develop more positive perspectives, they may be able to stay in school longer. Cognitions can be modified, and future studies should test interventions that work to

improve cognition in childhood, guided, for example, by principles of cognitive behavioral therapy.

What is already known on this subject?

There is likely some association between mental disorders and educational attainment, with poor mental health in childhood and adolescence being associated with lower educational attainment. The relationship, however, is not consistent across all studies, and there is great heterogeneity in study methodology, with a predominance of retrospective designs. Moreover, very few studies have been conducted in low and middle-income countries (LMIC), and the relationship between psychological wellbeing and education may differ from those in high-income countries (HIC), primarily due to the potential exposure to the multiplicity and chronicity of adversity that many children in LMIC face.

What do we now know as a result of this study that we did not know before?

Our findings suggest that cognitions (how positively or negatively a child perceives herself and the world) may play a role in educational attainment in LMIC. The finding that more positive cognition predicts better educational outcomes is consistent with findings from HIC. To our knowledge, this is the first longitudinal study to examine the association between childhood mental health and cognition with future educational attainment in a LMIC and one of only a handful of studies examining the relationship between mental health and educational attainment. Further study, including rigorous evaluation of interventions that aim to change childhood cognitions, is needed to understand fully the extent and generalizability of this result. Policymakers, planners, and researchers designing programs that aim to increase educational attainment should consider the effects of cognitions and consider including interventions, such as those based on the principles of cognitive behavioral therapy, to address cognitions during childhood and adolescence.

INTRODUCTION

Education has positive impacts on developmental, health, and occupational outcomes, including self-esteem, life expectancy and earnings.¹ Children exposed to longer periods in education have wider positive impacts for society, with resultant lower levels of inequality and reduced health care costs.² In low and middle-income countries (LMIC), improving school progress, particularly in secondary and higher education, may lead to gains in per capita GDP and improvement in standards of living.^{1,3} South Africa, like many countries in sub-Saharan Africa, has a secondary school completion rate of under 50%.^{3,4} Mental health may be a contributing factor to a child's likelihood of making progress and remaining in school, as it is in many high-income countries (HIC).^{3,5} Furthermore individuals may be particularly receptive to changing patterns of cognitions and/or behavior during this period, and schools provide a potential platform to access many children.⁶ Existing research also suggests that offering mental health interventions in the home or school environment could be acceptable, feasible, scalable, and cost-effective.^{3,7,8}

A child's *cognitive style* describes how that child understands what is going on around her and attributes meaning to events: for instance, how good or bad a child believes the future will be. It may influence how she responds to potentially traumatic experiences and adverse circumstances.^{9,10} Negative cognitions have been associated with current and future depression and anxiety,^{11,12} lower educational attainment, and negative life events.^{13,14} Cognitive style may be particularly important to examine because altering negative cognitions is one of the core features of Cognitive Behavioural Therapy (CBT), which has a large evidence base of interventions addressing negative or unhelpful cognitions. Research from HIC on direct associations between cognitions and educational outcomes is inconclusive and focuses primarily

on educational achievement (test scores). A single longitudinal study examining the future effects of low childhood self-esteem, a measure similar to the Cognitive Triad Inventory for Children's (CTI-C) view of self, found that low self-esteem at ages 11 to 15 was associated with lower levels of educational attainment at age 26.¹⁵

There has been limited research in LMIC on associations between mental health and educational or other socioeconomic outcomes. Existing studies are retrospective and have shown an inconsistent association between mental health and educational attainment.^{16,17} Effects of mental health on educational outcomes in LMIC may differ from those in HIC because of the chronic deprivation and adversity that more individuals experience, lack of educational resources, and limited employment opportunities.

Accordingly, the aim of this longitudinal study was to examine the relationship of both cognitive style and emotional/behavioural functioning at ages 10 to 12 with educational progress five years later in a rural South African population. Our findings can inform the development of interventions to address childhood mental health and educational attainment.

METHODS

This longitudinal study was reported according to the Strengthening the reporting of observational studies in epidemiology (STROBE) checklist.¹⁸

Study site

This research was carried out within the Agincourt Health and Socio-Demographic Surveillance System (Agincourt HDSS), in Mpumalanga Province, northeast South Africa.¹⁹ Within the Agincourt HDSS, systematic socio-demographic data has been collected annually since 1992 in 27 rural villages across approximately 16,000 households. The area has extensive poverty, high HIV prevalence, and a large population of former Mozambican refugees.²⁰

The psychological data on children's emotional/behavioural functioning and cognitions was originally collected in 2007 on children in grades four and six from ten of 28 primary schools in the Agincourt HDSS.^{21,22} This data was linked to the Agincourt HDSS database (ethics clearance M960720 and M110138) in order to examine the longitudinal effects of childhood mental health on future educational progress. Subsequent education data was collected in 2012. Research ethics approval was obtained from the University of the Witwatersrand (M070221), the Mpumalanga Province Research Committee, and the Oxford Tropical Research and Ethics Committee (008-07). In addition, permission was obtained from the local Department of Education and School Governing Bodies following discussion and consultation.

Sample

In the initial study, 1,228 children in grades four and six (roughly ten and twelve years old) were invited to participate. The 28 primary schools in the area were stratified based on Department of Education performance ratings, and ten were randomly selected from that stratification. Parental consent and child assent was obtained for 85% of children at these schools. Eighteen students did not complete the questionnaires or were absent, leaving a final sample of 1,025 children. Five years later, 528 (51.5%) of these children could be located and linked to Agincourt population data to assess educational outcomes at roughly 16 to 18 years of age. Linkage requires that a child be resident in villages of the HDSS and that sufficient information on key identifiers be available. Children who resided outside of the Agincourt catchment area at the time of data collection would not be recorded in the data system. In addition, key identifiers were not available for all individuals in the initial sample (see **Figure 1** for a flowchart of participant retention in the sample).

Of note, 81 girls in our sample (16% of girls) were recruited into an HIV prevention randomized controlled trial in the interim period. Between 2011 and 2014, researchers examined the impact of a three year conditional cash transfer program for females aged 13 to 20 years on subsequent HIV status.²³ Participants in the intervention arm were paid 300 rand (\$30) per month if they attended at least 80% of school days in a month. The HIV status of the participants in both the control and intervention arms was assessed at enrollment and annually for up to three years. The trial found that neither school attendance nor new HIV infections differed between control and intervention groups, but that school attendance was very high (about 95%) in both arms.²³ We conducted a sensitivity analysis to examine if participation in the trial could account for any association between mental health and school progress.

Measures

Exposure variables

The 25-item child and teacher-reported Strengths and Difficulties Questionnaire (SDQ) was used to examine behavioural and emotional problems.²⁴ The SDQ is a widely used screening tool that gives a total difficulties score and a strengths/prosocial score. It has well-established validity and reliability and has been used across LMIC, including in Africa.²⁵ The SDQ Total Difficulties scale was selected for this study as it had good psychometric properties (analysis detailed in Cortina et al., 2013) and pilot testing with teachers in study schools. Classification for the SDQ scales was based on standard norms and were applied to determine primary prevalence rates for each outcome measure for the entire sample and by gender.²⁶ Each child's class teacher completed the SDQ.

The CTI-C was used to assess children's cognitive interpretations,²⁷ employing a 36-item, one-factor model to indicate how positively or negatively children interpret situations. Scores on the CTI-C can range from zero to 72, with higher scores indicating a more positive cognitive style. The psychometric properties of these scales were examined in detail to ensure their suitability for use in the population and are reported elsewhere.^{21,22}

Outcome variables

The primary outcome was the extent of educational progress the child made in the five years after the mental health data collection (number of grades completed during that period). Current grade was extracted from data obtained from the Agincourt HDSS and matched to individuals in the original sample using unique identifiers. We derived a variable to capture educational progress by calculating the number of grades the child had completed in the five academic years between assessments. This ordinal variable could range from zero to six grades. From this variable, we generated a binary variable representing 'no/limited progress' (grade change of 0-2) and 'some progress' (grade change of 3-6).

Confounding variables

A number of variables from the Agincourt HDSS database considered relevant to this context were examined. These included household socioeconomic status (SES), maternal education level, baseline grade, gender, refugee status, and child age. Household SES is a composite variable constructed from asset indicators, including access to water and electricity, characteristics of the dwelling, appliance and livestock ownership, and means of transport.^{28,29}

Data analysis

The associations between 1) behavioral and emotional problems and 2) cognitive interpretations at baseline with educational progress five years later were investigated using logistic regression.

We first investigated the associations between each exposure variable and the outcomes in separate models and a combined model, adjusting for baseline grade. In a final combined model, we also adjusted for the confounding variables described above.

RESULTS

Descriptive results

A sample of 443 (83.9% of those matched, 43.2% of the original sample) individuals had complete data across all exposure, outcome and confounding variables. Characteristics of this sample as compared with the baseline sample are given in Table 1. There was no evidence for difference across the two samples, suggesting that attrition was non-systematic.

Table 1: Sample Demographics

	Baseline Sample <i>n</i> = 1028	Complete cases <i>n</i> = 443	P value of the difference
CTIC-C , Mean (SD)	43.9 (11.5)	44.4 (11.4)	0.018
SDQ Mean (SD)	15.0 (5.0)	14.7 (5.0)	0.055
SES Mean (SD)	2.43 (0.39)	2.47 (0.37)	0.307
Maternal education class	42.0 % classed as 8- 15 years	42.5 % classed as 8-15 years	0.511

A sensitivity analysis suggests that the 81 females who were included in the conditional cash transfer RCT²³ did not systematically differ from the other females in the sample.

At the time of follow up, 9% had moved zero or one grade, 27% moved two grades, 56% moved three grades and only 8% moved four or more grades, up to at least grade nine. Eleven students in the sample had completed a Senior Certificate, which is awarded upon graduation of high school (grade twelve) in South Africa. This is 6% of the 190 students who were in the highest grade at the time of original data collection, and thus the only ones who might have completed a Senior Certificate in the elapsed time.

Association between emotional and behavioral problems and cognitions with educational progress

As shown in Table 2, there was a robust association between more positive cognitions and likelihood of progress (moving at least three grades), taking into account baseline grade. This association was relatively unaffected by adjusting for emotional and behavioral problems as well as by adjustments for age, SES, gender, and refugee status. For a one standard deviation increase in CTIC-C scores, individuals are 1.43 times more likely to have completed three or more grades during the six-year study period (95% CI 1.14-1.79, $p < 0.002$). There was no evidence for an association between SDQ scores and educational progress before or after adjustments. In our final multivariable model, there was evidence that boys were less likely to make progress (95% CI 0.35-0.81 for male, $p < 0.004$) and those from a higher socioeconomic status were more likely to make progress (OR 1.96, 95% CI 1.10-3.49, $p < 0.021$).

Table 2: Logistic regression analysis investigating associations between emotional and behavioural problems and cognitive interpretations with educational progress

	OR for making progress (95% CI), adjusted for baseline grades only	Mutually adjusted OR (95% CI)	Mutually adjusted plus further confounding variables OR (95% CI)
SDQ (OR for a 1 SD increase in SDQ score)	0.87 (0.71 to 1.05) $p = 0.165$	0.88 (0.72 to 1.08) $p = 0.227$	0.90 (0.72 to 1.11) $p = 0.324$
CTIC-C (OR for a 1 SD increase in CTIC-C score)	1.48 (1.19 to 1.83) $p < 0.001$	1.47 (1.18 to 1.83) $p < 0.001$	1.43 (1.14 to 1.79) $p = 0.002$

Sensitivity analyses for the subsample of 81 girls who participated in the conditional cash transfer RCT showed increased educational progress for both control and intervention groups, relative to those not in the trial. 78% of girls in either arm of the trial, but only 63% of girls not

in the trial, moved two grades or more. There was no evidence for difference in educational progress between those in the control or intervention arms. When participation in the RCT was adjusted for, the association between cognitive style and educational progress was nearly unchanged (OR 1.42, 95% CI 1.13 to 1.78, $p=0.002$). However, there was no longer evidence for a gender effect on educational progress (adjusted OR 0.84, 95% CI 0.49 to 1.44, $p=0.526$).

DISCUSSION

To our knowledge, this is the first longitudinal study in a LMIC to examine the effects of childhood cognition on educational progress. The central finding of this study is that a positive cognitive style during middle childhood is associated with greater educational progress in the adolescent years, after adjusting for a range of baseline confounders (for a one standard deviation increase in CTI-C, 1.43 times more likely to complete 3 or more grades (CI: 1.14 to 1.79) $p=0.002$). Unlike many factors that affect school progress, cognitive style is potentially modifiable and may be easier to change during childhood than adulthood.³⁰ Addressing cognitions could be a key component of interventions to improve school progress and reduce school dropout, especially for children who face situations of chronic adversity.

Our findings are consistent with some HIC studies that examined the relationship between cognition and educational outcomes in children or young adults using a variety of measures of cognition and educational outcomes. These studies found that more negative cognitions are significantly associated with worse educational outcomes.¹⁵ Other studies, however, have not found an overall effect of cognitive style or have seen an effect only in certain subgroups.¹² Children and adolescents in LMIC may face a different magnitude of adversity and have fewer sources of support than those in HIC,^{4,31} perhaps explaining why their cognitive response has a

greater role in educational outcomes in our results. Notably, most cognitive studies in HIC examine educational achievement, such as test scores, rather than educational progress, further explaining differences in results.

In contrast to our findings on cognition and educational progress, we were curious as to why emotional and behavioural problems, as measured by the teacher-reported SDQ, were not associated with educational progress. Previous studies of mental health and education in LMIC and HIC have found an association between poor mental health and lower educational progress.³²

There are two ways we could explain this difference between our results and prior research.

First, our study was conducted in rural South Africa, as distinct from the settings of other studies where adolescents may face greater challenges to mental health and educational attainment. In a context in which a much higher proportion of children are exposed to extreme hardship, cognition may be a stronger predictor of educational progress than mental health. Second, the SDQ is designed to assess a child's behaviour and emotions, rather than whether the child meets diagnostic criteria for a mental illness. If we had used tools designed to diagnose mental disorders, as has been done in prior studies, fewer but more severe cases might have been identified possibly leading to a greater difference in the educational progress of children meeting diagnostic criteria for mental disorders.

This study has potential implications for policy and interventions. Given that cognitive style predicts educational progress in our study, cognition-based interventions, utilising the extensive knowledge-base derived from studies in CBT,²⁹ could potentially facilitate a more positive cognitive style for children who have negative cognitions or are at risk of school or therapeutic dropout. Teachers, social workers, and non-specialist health workers,³³ including community health workers have been trained in administering therapies based on the principles of CBT,

making these time-limited interventions potentially scalable and may be applicable in promoting self-help strategies.³⁴

Our results suggest a number of areas for further investigation. First, our findings regarding cognition and school progress should be tested in other settings to determine the generalizability of these findings. Second, the majority of studies on cognition-based interventions have taken place in HIC and focused on changing cognitions as evaluated by altered mental health outcomes, rather other broader functional and life outcomes.³⁵ Examining interventions that use CBT to target cognitions in adolescents in LMIC who do not have a mental disorder and evaluating outcomes related to education, interpersonal relationships and employment are important and would be of interest. Third, it remains unclear if childhood cognitions have an effect beyond late adolescence, such as on adult employment, assets, or health outcomes. We can infer from studies on the long-term benefits of secondary and tertiary education in LMIC that increased completion of secondary school will affect long-term economic outcomes but it is not clear if more positive cognitions will have effects beyond those mediated by education.^{36,37} Studies conducted in a health and socio-demographic surveillance system, such as Agincourt, are ideally suited to this type of long-term follow-up study, but, the large attrition in our sample demonstrates how retaining a sample can be challenging, particularly in low-resource areas with large migrant populations. Fourth, cognitive style may be a key factor in determining how children respond to chronic exposure to adversity or potentially traumatic events. In this population identified risk factors in relation to SDQ Total Difficulties scores included being a second-generation former refugee and having a more educated mother was found to be a protective factor.²² While there is a growing body of literature on the role of resilience in children in LMIC,^{8,10,38} little is known about how to build resilience or the cognitive processes

that underlie resilience. A better understanding of the connection between resilience and cognition could further inform the development of interventions that target cognitions, which may be more amenable to interventions than other determinants of resilience, particularly in former refugee populations and those with lower parental education.

This study has a number of limitations. First, just over half of the 10-12 year-olds who were sampled at baseline were not included in the analysis because of incomplete data (n = 582 of 1025 excluded). Incomplete data occurred for a variety of reasons, including the high rate of migration in the area. However, the sample in this study does not significantly differ on baseline variables, including cognition, from the original sample, which suggests that the attrition has not biased results. Additionally, given the paucity of data on mental health, cognition, and educational outcomes in LMIC, our findings remain important for informing future research. Second, we conducted this study using data from the Agincourt HDSS, which collects preset variables at fixed time intervals. Some variables were collected every two to four years, rather than annually, limiting coverage of all time periods. Third, some of the individuals in our sample were also included in a conditional cash transfer RCT, which could have modified the effect of cognition on future educational progress. The sample included in the RCT did not differ on baseline variables, except gender, and the effect of cognition on educational progress remained robust even after we adjusted for participation in the RCT. Potential Hawthorn and selection effects may explain the difference between trial participants and girls not included in the trial.³⁹ Lastly, the tools used to gather these data had not previously been validated in African populations, however, the psychometric properties of the tools were examined and the tools were deemed suitable for use with this population.²¹ Examination of internalizing and externalizing problems may reveal additional insights, however was not possible in this study due to the

conservative analysis approach taken using only scales with good psychometric properties in the specific population.

CONCLUSION

Many children in LMIC face difficult life circumstances and socioeconomic deprivation, including exposure to extreme poverty, traumatic events, HIV, bereavement, and early entry into employment and care-taking roles. Our findings from rural South Africa suggest that if a child is able to develop a positive view of herself, the future and the world around her then she is more likely to attain better educational progress. Interventions that strengthen childhood cognitive style have the potential to reduce school dropout and increase educational attainment in LMIC and thus improve trajectories throughout the life course.

Declaration of interests

The authors declare no conflicts of interest.

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